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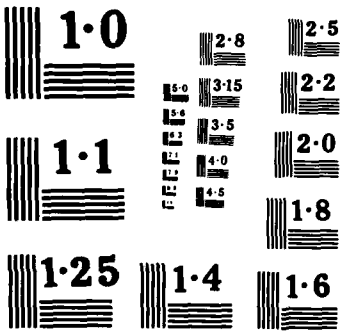

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The basic question is whether the Army uses the study process as a tool to aid in decision making or a way to postpone having to make a decision. The question was examined using studies pertaining to combat vehicle systems since 1970. Data was gathered from a literature search, examining studies found, going through files to examine the correspondence that accompanied many of the studies where such correspondence was still available, and conversations with people who were involved in the conduct of many of the studies. It is concluded that

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20. although studies are generally being used to aid decision making, they are not exploited to their full potential. They may not be available due to restrictions or oversight, or they may have taken so long to complete that the question was answered by other means. It is also concluded that decisions made as a result of studies are not always implimented due to lack of resources, goal consensus, or the absence of resolve on the part of the decision maker to make it happen. The Army should require that: all studies be filed in DDC or DTIC, a literature search be a requirement for all studies, goal consensus be reached before starting a study, complex studies be simplified, decisions made be resourced and lastly, when the decision is made to implement an action, all persons involved should support that decision.

USAWC MILITARY STUDIES PROGRAM PAPER

THE STUDY: A TOOL FOR DECISION?

AN INDIVIDUAL STUDY PROJECT

by

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22 April 1985

ABSTRACT

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The basic question is whether the Army uses the study process as a tool to aid in decision making or a way to postpone having to make a decision. The question was examined using studies pertaining to combat vehicle systems since 1970. Data was gathered from a literature search, examining studies found, going through files to examine the correspondence that accompanied many of the studies where such correspondence was still available, and conversations with people who were involved in the conduct of many of the studies. It is concluded that although studies are generally being used to aid decision making, they are not exploited to their full potential. They may not be available due to restrictions or oversight, or they may have taken so long to complete that the question was answered by other means. It is also concluded that decisions made as a result of studies are not always implimented due to lack of resources, goal consensus, or the absence of resolve on the part of the decision maker to make it happen. The Army should require that: all studies be filed in DDC or DTIC, a literature search be a requirement for all studies, goal consensus be reached before starting a study, complex studies be simplified, decisions made be resourced and lastly, when the decision is made to implement an action, all persons involved should support that decision.

PREFACE

This study project was produced under the aegis of the US Army War College. The scope and general methodology were selected by the author. After initiation of this study, I was precluded from making a planned trip essential to gather the details for this effort. Telephone conversations and research of documents provided by other agencies were substituted for the planned personal interviews. This constraint caused considerable difficulty in gathering data. Therefore the results are neither as specific nor as detailed as originally planned. Much of the information used in this study came from conversations with officers and members of civilian contract firms who have had extensive experience with the studies and tests cited herein. What I have portrayed in most cases represents the consensus of those conversations. Several of these individuals have requested not to be identified due to the sensitivity of their current position. This request has been honored.

Special thanks should go to Maj(Ret.) William E. Jones, HQ, TRADOC, Ft Monroe, Va.; Col Robert DeMont, DCD, USAARMC, Ft. Knox, Ky; Col James Welsh, PM, AGS, USATACOM, Warren, MI; and Maj(P) Michael Jones, USAAREBD, Ft KNOX, KY.

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CHAPTER I

INTRODUCTION

BACKGROUND

During the past 14 years, I have been associated with a number of studies concerning either the development of future armored combat vehicle systems or improvements to existing systems. The opinion of many in the research and development (R&D) community is that we are always studying the same problems and coming up with essentially the same (or very similiar) answers. This idea of repetition was particularly brought home to me in the summer of 1982 when, at a party, a senior officer who knew of my R&D background was eagerly telling me of the new study efforts being initiated at the Armor Center. When he finished his description, I replied that the new studies seemed to be a re-look at areas previously studied by the Armored Combat Vehicle Technology (ACVT) Study completed less than a year earlier. His answer was to the effect that he was aware of ACVT, but that there might be some new data or something that was overlooked by it, so it was necessary to look again. On the surface, this approach appears wasteful in that it is continually searching through the same data and therefore not making much progress. This tends to impede rather than encourage progress. To those who work on these studies, it is also frustrating in that the action officers seldom see anything come from their efforts. The ignoring of the results of a recently completed study also is inconsistent with AR 5-5 which states that "studies are analytical examinations to assist Army decisionmakers."[1] Therefore, when

offered the opportunity to conduct an independent study, this appeared to be a subject worthy of investigation.

STATEMENT OF THE PROBLEM

To determine if the study process as commonly employed by the Army is a tool for decision making or a way to postpone having to make a decision.

LIMITATIONS

In order to keep this study to a size manageable by one person, I narrowed the investigation to a single field with which I had some previous experience: armored combat vehicle systems. I further chose to limit the scope to those studies conducted since 1970. My preliminary investigation had identified seven studies conducted in the field of combat vehicles during this time limit. For the purposes of this paper, the studies examined will include a number of scientific experiments labeled "tests" where the objectives of these tests were to expand the knowledge base and answer specific questions. The terms "study" and "test" will be used interchangeably in this paper.

INVESTIGATIVE TECHNIQUE

I planned to conduct a library search to include the Defense Technical Information Center (DTIC) and the Defense Documentation Center (DDC) to identify any additional studies and to obtain copies of those relevant to my effort. I also knew that most of those studies already identified were available at either Headquarters, TRADOC, or at the Directorate of Combat Developments (DCD), US Army Armor Center. If possible, I planned to read the documents at those locations when I visited and reproduce only those portions needed so as to save costs to the government. Using the matrix at figure 1 as

Study Title	Mob Agil	Leth-ality	Surv-ivabl	Strat Mob	Tac Mob	Whl vs. Trk	Gun vs. Miss	Life Cyc Cost	Cost Eff	Results/Comments

Figure 1.
Matrix

a guide, each study would be examined to determine what issues it addressed, the answers it provided, and the decisions made as a result of the study. From this matrix, I would then be able to determine if the same or similiar issues were addressed by more than one study. Using this data as a departure point, I planned to discuss the process of how the studies were conducted with people who had participated in them in an attempt to determine why repetition, if any, occurred, and thereby gain insights into the special techniques or problems of each study. The preferred method of conducting these interviews was to be face-to-face where possible so as to allow the dynamics of a give-and-take conversation to bring out the pertinent points. Where face-to-face contact was not possible, the interview would be conducted by telephone.

CHAPTER II

INVESTIGATION

REVIEW OF THE LITERATURE

A search of the card catalogues in the Army War College Library and the Military History Institute yielded nothing within the timeframe of this study. I then asked the librarian to enter a keyword search of the DIC and DTIC to identify studies that might be available. From this effort I received twenty titles, most of which were identifiable by title as clearly outside my area of study. One of the twenty seemed to offer potential. I requested that document and discovered upon its arrival, that it reported the results of a Navy torpedo test. After some further telephone calls to old friends, I had expanded my list to eleven titles. I then asked the library to go back to DTIC and DDC with those titles and see if the studies were available. The library located only two of the eleven. I then concluded that I would have to obtain the bulk of my material from locations which had them on file, either through personal visits or by requesting that copies be sent to me.

This library search effort served to identify a problem of the study system; the failure to store a record of what was done in a given study so that it can be retrieved. If this is a common practice, it does not comply with the intent of AR 5-5 which states that "studies will build on results of current or previous studies, research, and tests. They should not unnecessarily duplicate other analytical work."[2]

While the working level of the Army has continued to procrastinate, the high level leadership has continued to insist on getting something for the light division. When the MENS was approved, it was intended that the Army purchase an interim solution while it developed the vehicle described by the MPG and ACVT Studies. A joint Program Management (PM) Office was established per Office of the Secretary of Defense (OSD) direction, at TACOM for the purpose of developing a common system acceptable to both the Army and Marine Corps. This effort was unsuccessful and the joint program died in 1984. There have been a multitude of meetings within the Army on the MPG issue, but the user and the Army leadership have not been able to reach a consensus on the concept of employing the weapons system with light forces. The key issue seems to be whether or not the system needs to be transported by air. Air transportability constrains the size and weight of the system which in general, tends to limit its survivability and lethality.

Since nothing has been done, the Army is considering an option to bring a number of M551 Sheridans back from the scrap yard, to be refurbished, and placed into the light force to satisfy the immediate requirement, while the MPG, now renamed the Armored Gun System (AGS), is being developed.

Meanwhile, the USMC PM Office has completed the buy of their LAV and is in the process of closing down.[16]

HAS THE ACVT STUDY DATA BEEN USED?

Other than the MPG Study and the Army/Marine use to develop the MPG/AGS/LAV, I can find no use of the data providied by ACVT. The subsequent studies, mostly conducted at Fort Knox have primarily been concerned with the Main Battle Tank. Since the ACVT Study primarily focused on lighter vehicles, it has been dismissed as not applicable.

Mobile Protected Gun (MPG) Study accomplished under the auspices of the Infantry Center and in close coordination with the ACVT Study Director and TACOM PM. It was charged to"investigate the need for a light, anti-armor offensive system to augment the firepower of light divisions currently being designed for the 1986 timeframe and beyond."[15] The results of this study were briefed to the VCSA in September 1980. Both the Army and the Marine Corps used the MPG Study as the basis for a Mission Element Needs Statement (MENS). The USMC MENS for a helicopter-transportable Mobile Protected Weapons System (MPWS) was approved by the Office of the Secretary of Defense (OSD) in March 1981. The Army MENS for a MPG was approved by OSD in September 1981, the same month that the results of the ACVT Study was briefed to the CSA and HQ,USMC. Thus, while the questions were answered, the larger effort turned out to be almost anti-climatic.

WHAT DID IT PROVIDE?

The ACVT Study provided a wealth of data to answer a variety technical and conceptual questions. The essence of these questions was published in the three volume report. However, much more information is available on the computer tapes in the library at the Armor and Engineer Board, Fort Knox, Kentucky.

WHAT WAS DONE WITH THE INFORMATION?

The USMC bought a Light Armor Vehicle (LAV) which they feel provides a solution to their requirements. It is not exactly as described by either the MPG or ACVT Studies, but was an existing 8X8 wheeled armored vehicle which was modified to accept various weapons systems.

Study had many subtests and studies from which it gathered data, most of which would have in themselves qualified as major efforts if they were not designed and funded as a part of this study.

A significant subtest of ACVT which provided many answers on the worth of mobility and agility in a force-on-force scenario was the Advanced Anti-Armor Vehicle Evaluation (ARMVAL) Test. This test was conducted by the Marine Corps Development and Education Center (MCDEC) with Army participation and support. It was conducted on a fully instrumented battlefield (similiar to that at the National Training Center) at Fort Hunter-Liggett, California. It pitted a unit equipped with specially modified (for high mobility/agility) M551 chassis against a representative conventional Soviet force composed of M60A1 tanks and M113 armored personnel carriers. It demonstrated that a properly trained and disciplined force equipped with more agile but less lethal vehicles could defeat a heavier force.

In the end, the ACVT Study described a lightweight combat vehicle systems in terms of main armament, rate of fire, fire control system sophistication, gunner's station, mobility/agility and armor protection. It recommended different weight vehicles for the Army and the USMC due to the USMC requirement for the system to be helicopter transportable. The results were briefed to the Chief of Staff, Army and Headquarters, USMC in September 1981, and published in three volumes in June 1982.

Normally, we would expect that the results of an effort as extensive and as expensive as this, and which was successful would be used. This was not to be. Because the study was delayed over a year by the difficulties in getting the new and high risk subsets of the study to work together coupled with a perceived change in the threat, the Army leadership became impatient for an answer. As a result, a side study was conducted between January and October 1980 which used much of the data already developed by ACVT. This was the

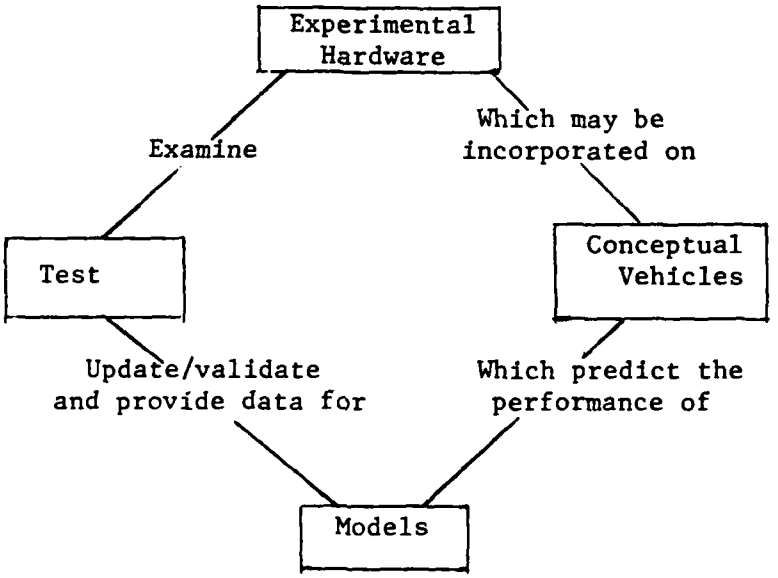

Figure 2.
ACVT Study Methodology

> Establish the technical and concept feasibility and military potential for LCVs (lightweight combat vehicles) and MC-AAACs (medium caliber anti-armor automatic cannons). Enable the Army and USMC to determine appropriate actions to be taken in regard to development of LCVs and MC-AAACs.[13]

The study methodology involved testing of experimental hardware and updating computer models. The models were then used to predict the performance of the various items of hardware which may be incorporated on various conceptual vehicles. A diagram of this effort is shown at figure 2.[14]

The ACVT Study was an elaborate combination of research into what had taken place in the past, upgrading of computer models, construction of high-performance test vehicles and weapons systems and development of new test equipment. Coordination of the study was conducted by a System Manager working directly for the Vice-Chief of Staff, Army (VCSA). The major effort was controlled by a Study Director located at Fort Knox, Kentucky and a Program Manager (PM) at the Tank-Automotive Command (TACOM), Warren, Michigan. The ACVT Study used two prime contractors to build experimental vehicles in different weight ranges. Both vehicles mounted the same 75mm MC-AAAC firing a newly designed, more compact round of ammunition. The vehicles both had automatic loaders, but of different design. Each had a different, but highly advanced fire control system which allowed them to direct automatic fire at moving targets while they themselves were moving. One vehicle even incorporated a "Hunter-Killer" system which allowed the vehicle commander to acquire a new target while the gunner was engaging a different target.

This effort to simultaneously test two different, entirely new, very high technology (and therefore high risk) systems involved complications and delays due to failures and breakdowns of one-of-a-kind parts. None the less, the vehicles were built, tested using some new state-of-the-art equipment, and the data from these tests then placed into the updated computer models. The ACVT

CHAPTER IV

ACVT: A CASE STUDY

In going through the material and in my discussions with the various people, I kept coming back to the same question: What do we do with the information we learn? This is a sort of expansion of one of the questions posed at the end of Chapter II: Why have some studies built upon the previous data, while others have not? An examination of the ACVT Study provides an interesting vehicle to answer this question. I offer this examination with some trepidation because of my involvement with the study during its last two years. It is not my purpose to push it as the answer to everything, for it certainly is not. It was, however, an extensive effort which in its formal phase took four years and cost well in excess of 150 million dollars.[12] It is also an example of what happens when a study is delayed, the repetitive use of the same data to answer the same or similiar questions, and the failure to use many of the answers after they have been provided.

WHAT WAS ACVT

The ACVT Study was an outgrowth of a 1972 Defense Advanced Research Projects Agency (DARPA) sponsored effort to develop a smaller, more effective kinetic energy (KE) tank ammunition. This effort was combined with mobility and survivability testbeds the Army was testing and in 1977 became a formal program of the Department of the Army with US Marine Corps, DARPA and British Army participation. The ACVT Study also researched previous studies so that it could build upon what was already known. The program objectives were to:

Thus we can see in this example a reluctance to deal with solutions that are outside the boundaries we have set for ourselves.

Lastly, a not insignificant part of this problem is the failure of the decision maker to record his decision in writing and sign it. The result is that afterwards all the staff officers argue over "what he really meant was...". This happens almost everytime a general officer or other high level official makes a decision, regardless of the subject.

SUMMARY

All of the points discussed above have some validity; they also have their flaws. The bottom line is that much effort is wasted for a number of reasons, some good, and some not so good. We spend a lot of valuable time and resources going nowhere. It takes too long to analyze all of the components that go into the decision process and build consensus, which is often the result of support trade-offs. When agreement is finally reached, a number of variables may have changed: the threat, the strategy, the doctrine or the administration. Then, in response to these changes and a possible variety of challenges, we go back and do parts of the effort over again.

alternatives" and "complicates decision with peripheral analysis.[9] This TRADOC effort, while not within the narrow scope of this paper, is, however, related in that it is an attempt to address the overall problem of re-examining study issues and the wise use of time. It also noted that the Army was the only service to use this "bottom up" approach. The other services form consensus first and then conduct whatever analysis is required to support their goals before the Congress.

One view expressed which tended to combine the "turf" school of thought with the idea that technology is moving faster than most of us realize was that, "technology is changing fast enough that you can no longer describe requirements along traditional combat arms lines."[10] The belief expressed here is that we tend to evaluate a system too narrowly. We usually develop requirements on a branch basis (i.e. armor, infantry, etc.) as opposed to a force basis (i.e. close combat, heavy). When this issue is discussed, most people will tend to agree that development should be on a force basis, especially those at the general officer level. The problem then becomes how to convince the lower levels to accept that attitude and accomplish their actions on a force basis. The problem is that we, as individuals in the Army, have trouble accepting solutions that are outside our own, self-imposed, narrow boundaries. When "we" are the action officers and decision makers of the Army, our sometimes narrow solutions become the Army's position. This view was underscored in a report of a 1980 meeting held at the Armor Center:

> The Armor Center is not against a light tank. In the heavy (tank vs. tank) mission role, the Armor Center does not see a place for it . . . they believed the infantry has a need for something, but the Infantry Center must define what. The Armor Center is willing to work with the Infantry Center in this definition process and is prepared to accept proponency for a light tank if that is what the Infantry Center decides is needed.[11]

roles" on the battlefield. This rivalry is also observed at DOD level between the services.

There also seems to exist, a variety of "us versus them" conflicts. These take the forms of military distrust of civilian thoughts (i.e. civilians don't really understand what its like on the battlefield), civilian disdain of the military (i.e. GI's just can't make it on the outside) or the "old timers" having to put up with the questions of the younger people just coming into the R&D business. This latter attitude crosses the military-civilian lines. There is also an inherent distrust of contractors (everybody "knows" that they are out to get rich at the taxpayers expense) by DOD personnel, both civilian and military.

The problem with these conflicts is that they become self consuming entities. The people who are supposed to be expending energies developing better ways for the Army to do its job, instead spend a lot of effort pushing their system or idea and decrying the value of all other systems or ideas which compete with it for resources. Here again, attempts to prove why one system is worth more than another system tends to be a iterative process which has us repeating and rejustifying what we have already done.

This constant tendency to attempt to force the bureaucracy to return to the start point, for whatever reason, is something that it fights. By its very nature, the bureaucracy wants to move ahead, not always quickly, but in its own way, and according to its own rules. When it is pushed backwards it tends to go into a tailspin from which it has difficulty pulling out. This phenomenon was also observed by recent TRADOC sponsored study designed to identify to build consistency in their COEA study efforts. The report noted that the "Army attempts to use analysis to build consensus for decision-'bottom up'", and further pointed out that this approach "tends to restudy 'dead issues', rejustifies existing requirements, introduces or relooks many

technology. Essentially, this view expresses a concern toward the validity of the intelligence community's estimate. "We get halfway toward what we want to build and the Threat Community comes in with another overly pessimistic assessment crediting them with another new technology."[7] In other words, if we build a better armor, then the other side suddenly is credited with a better bullet. With this kind of intelligence support, we will never be able to catch up.

"As people change, old lessons are lost and people tend to repeat history."[8] This represents the view from the opposite end of the spectrum. It is a comment frequently heard from those who have tended to remain in the R&D field on a continuous basis. Essentially it describes the turbulence problem at the upper leadership levels of the Army. The commonly held view is that when someone in a key position (i.e. director level of the DA staff, project manager, or center commander) is replaced, the new person often tends not to accept what was done by his predecessor. When this happens, the system has to stop where it is and go back and rejustify what it is doing.

Another causal theory cites "turf" battles, traditions, and "us versus them". Internal conflict from several levels and in a number of different directions was an almost consistently expressed attitude by those involved in the development process. This aspect takes many forms.

Such a "turf" battle may be a system supported by one branch (i.e. an artillery-fired top attack munition) viewed as a threat to a different weapons system being developed by another branch (i.e. a new tank gun for armor or missile for use by infantry and attack helicopters). Since the amount of money in the Army's budget is not infinite, these systems compete for resources. Thus battle lines get drawn around branches and their "traditional

CHAPTER III

ANALYSIS

The answers vary with the aspect from which one views the problem. The thoughts on what causes this apparent inconsistency are even more widely varied. The conclusions of this paper were developed from conversations with several people who participated in many of the studies examined plus my own personal experience with a number of them. The opinions are all subjective, therefore, so are the conclusions.

WHY DO WE REINVESTIGATE THE SAME ISSUES?

"The answer is simple. The technology keeps changing."[5] This represents the standard response from the more senior managers of the R&D community. It is one that I have heard for a number of years when discussing this point. It is not total rhetoric however. Most people agree that the technologies do change, but usually very slowly. Experience has shown that when significant technological breakthroughs occur, the effect is usually widesweeping in that it not only affects other technologies, but usually influences doctrine and tactics as well. It also generally causes a speed up of efforts by the other (political) side to develop a counter to any technological advantage that may have been gained by the side making the breakthrough. This phenomena is not new, but has been going on for years. Historian Michael Howard observed that "any advantage given by the possession of technically superior weapons was temporary and unlikely in itself to be decisive."[6]

A slightly different view of this thought is that it may be that the Threat's technology is only perceived to change faster than does the friendly

CONCLUSIONS

The surface conclusions that the matrix provides are that:

- There appears to be considerable overlap in a number of areas.
- Some studies have built upon the previous data, while others have not.
- Not all previous data is available to researchers.

These conclusions all generate the same question: WHY?

The answers are not discernable from the studies listed. They can only be provided by talking to people who were involved with them.

limited scope of this study, they do point out that the problem of studies not being used once completed is wide spread and is becoming a concern at the highest levels.

ANALYSIS

The studies which fit the parameters of this effort are listed in the matrix found in Appendix A. A glossary of terms is Appendix B to assist in reading the matrix. A simple item count of the matrix quickly shows where the priority of research has been concentrated for the past dozen years. In order, the categories were survivability (23), mobility/agility (19), tactical mobility (17) and lethality (13).

It should also be noted that eight of these tests or studies (indicated by "*") were either partially or entirely used by a study whose sheer effort in terms of cost and length of time expended overshadows all other efforts: the Armored Combat Vehicle Technology Study. Additionally, the ACVT Study used data from seven other studies and tests in building its data base. Three of those are shown at Appendix A (indicated by a "+"). Of the other four, one was a test conducted in Germany, and three were technical data producing tests which do not fit the matrix.

Of the remaining fourteen studies, five deal exclusively with main battle tank issues, one with large caliber gun technologies, four are investigations into conceptual fighting vehicle systems for the future, two produced data to support modeling efforts, and two dealt with predominately anti-tank guided missile issues.

OTHER SOURCES

The visit to TRADOC Headquarters yielded a wealth of information. One of the first things I found was a reminder that I was not the first person to be concerned about repetitive efforts. In late 1979, General Donn Starry, then TRADOC Commander, in an attempt to kill a DA directed study which was suffering large cost and time overruns had written a note to his staff asking, "What do we know about mobility/agility and its effect on battlefield survivability?"[3] The answer he received was that a total of sixty-eight tests/studies had been identified which addressed that issue; thirteen of which were considered significant. However, the reply pointed out, while there were a number of things already known, there were an equal number of issues that were still unanswered, and that the on-going study had the potential to answer most of those questions. That reply also noted that there were some issues that might never be answered. That list, along with the eleven previously identified studies plus two additional ones discovered, yielded a total of twenty-five significant studies or tests conducted concerning the subject of armored combat vehicle systems since 1973. These tests were reviewed if available. For those not available, pertinent documents or other summary material was examined to ascertain the areas each study addressed.

I should also mention here that during the course of my investigation, I found that the current CG, TRADOC is concerned with the study process in general and the Cost and Operational Effectiveness Analysis (COEA) in particular. Additionally, this same concern is being expressed at DA level in that the Director of the Army staff recently issued instructions to the heads of the Army staff agencies that henceforth there is a requirement for assignment of a general officer "to oversee the implementation of the ASB [Army Science Board] recommendations."[4] While these two efforts do not directly affect the

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

ANALYSIS OF THE METHODS USED

The methods used in this study were mostly subjective. To construct the matrix required reviewing the studies to determine what they measured. Unfortunately, it was not a tool which allowed finite resolution. Subject categories are broad generalizations within which many different dimensions can be examined individually. However, such refined measurement would have tended to lead the study into a measurement of minutia rather than a broad examination of how we accomplish the study business. In this respect, the matrix was useful to identify and generate questions.

The interview was intended from the outset to be the main information gathering technique. It was envisioned to be a combination of one-on-one and small group discussions. However, travel limitations restricted this to a few individual, mostly telephonic, conversations with people who had firsthand knowledge of the process and many of the studies involved. Not all agreed on every topic. Therefore, the views expressed represent the majority opinions in most cases. In a few instances, a single subject would elicit variations which were skewed by the perspective from which the person had viewed the action, his role in it, and a certain amount of organizational bias. In these cases, the views expressed represent my sorting and evaluation of what was said and in a few instances, my personal experience with the subject in question. I have attempted to represent the data and conclusions drawn from it fairly in all instances.

The point of lack of information availability in the library system was an accidental discovery. It has been reported as it happened.

Finally, this examination may not be applicable to all Army studies. The vehicle development and testing business is high cost and high risk. It often crosses branch and service boundaries. Therefore, all efforts in this area offer the potential for conflict both during the conduct of the study or test, and with the interpretation and use of its results. The indications are, though, that these views may be valid with at least the hardware oriented studies if the actions of the CG, TRADOC and the Director of the Army Staff are valid indicators.

CONCLUSIONS

- o Studies are being conducted as a tool for decision making. However, the decision is often not what was expected. It may sometimes be to proceed or not proceed with a program. Other times, it may be to conduct another study either of something new that was surfaced in the study, or of a question that was not asked in the original effort.
- o The data provided by studies is not always used.
  - oo This maybe because it was not placed in the library due to an oversight, or because someone in authority wanted to restrict access to the information.
  - oo It may be because the data is not applicable to the subject under study, even though from the general category it may seem to those outside the study that it is.

- oo Sometimes it may be because of a conscious decision by the agency directing the study that the new study will not use the old data. This decision, if not carefully made, could be in contravention of AR 5-5.

- o Complex studies tend to lose their impact upon the problem they attempt to address.
  - oo They get delayed due to the intertwining of their parts resulting in small problems holding up the whole effort.
  - oo This delay is exacerbated by the American impatient nature. We would often rather have a quick and dirty answer that will allow us to proceed, than to wait for the absolute proof.
- o Decisions made are not always implemented.
  - oo The resources to implement a decision are sometimes not available.
  - oo The resolve of the decisionmaker to have the program implemented is not always there. By leaving implementation to subordinates several layers down the organization, it will get done only if that subordinate and the leaders at the intermediate levels reach consensus that they want it to happen. Otherwise, it may become an obscure issue.
- o The lack of goal consensus allows internal resistance to slow the process. This is almost exclusively an Army problem. Without a clear definition of what the desired outcome is, its attainment becomes difficult.

RECOMMENDATIONS

- Department of the Army should require that all studies be filed with either the DDC or DTIC. Restrictions for release may be included, and may even require case-by-case approval of the study proponent. However, the knowledge that the study exists should be available.
- A literature search should be required in all studies.
- Studies should be kept as simple as possible. Multiple issues may often be structured sequentially and thereby more quickly answered individually. This will allow more data to be available earlier. It may also preclude single item delays from stopping progress on larger programs. When it becomes necessary to construct a complex investigation, this should be done with a complete recognition of the potential problems involved.
- Goal consensus should be reached prior to starting a study or implementing a program.
- When a decision is made to implement an action, it should be recorded in writing and resourced by the decisionmaker. If it cannot be resourced, a decision must be made to either hold the program open for a limited time or kill it. Programs should not be allowed to remain unresourced indefinitely.
- The time honored principle of "getting on the bandwagon" when the boss makes a decision should be enforced throughout the Army. This concentration of effort helps ensure success of a program. The lack of it reflects an indisciplined officer corps. Those who do not comply with the decision should be removed from the program.

ENDNOTES

1. US Army. Department of the Army Pamphlet 5-5. Guidance for Army Study Sponsors, Sponsor's Study Directors, Study Advisory Groups, and Contracting Officer Representatives. (Headquarters, Department of the Army. Washington, DC: 1982), p. 1-1.

2. Ibid., p. 1-2.

3. Memo to CG: HQ, USATRADOC, ATCD-M-T, subject: Interim Reply to CGAM 413, undated, with enclosures, p. 2.

4. Memorandum for Heads of Army Staff Agencies, HQDA, DACS-DMO, subject: Army Science Board Follow-up Plan, 18 Oct 1984, with enclosures.

5. This represents the opinion expressed by several Army Colonels, each with over fifteen years experience in R&D.

6. Michael Howard, War In European History. (Oxford: Oxford University Press, 1983), p. 121.

7. Telephone conversation with MAJ(Ret) W. E. Jones, HQ, TRADOC, 11 April 1985. I have heard this view has also been expressed by most people in the material development business at one time or another during my fourteen years experience.

8. Telephone interview with COL J. Welsh, P.M.. Armored Gun System, USATACOM, 5 March 1985.

9. Special Study Group, HQDA, DACS-DMO, "Review of Army Analysis Extended (RAAEX)" Briefing, 31 Aug 1984, conclusion slide.

10. Welsh.

11. MEMORANDUM FOR RECORD, HQ, USATRADOC, ATCD-M-T, subject: Trip Report-LTC Van Zant to Ft. Knox for Future Tank Presentation by TARADCOM, 20 February 1980.

12. Welsh.

13. US Army Armor and Engineer Board, Armored Combat Vehicle Technology Study (U), Vol. I: Executive Summary (Fort Knox, KY, US Army Armor Center, 1982) p. 2.

14. Ibid.

15. Director of Combat Developments, The Mobile Protected Gun Study (U). (Fort Benning, GA, US Army Infantry School, 1980) p. 125.

16. Consensus of telephone interviews with COL J. Welsh, MAJ(P) M. Jones and MAJ(Ret.) W. Jones, and others.

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APPENDIX A

Study Title	Mob Agil	Leth	Surv	Strat Mob	Tac Mob	Whl vs. Trk	Gun vs. Miss	Life Cyc Cost	Cost Eff	Results/Comments
Field Study of Effects of Mobility/ Agility on Target Presentation and Defender Reaction (HELAST II)	X		X		X					--Slight changes in observer position can result in significant changes in target visibility. --Increased mobility/agility significantly decreases the probability of being detected and/or fired upon. --Most rounds are fired at partially visible targets.
Tank Special Study Group (Otis Study)	X	X	X		X			unit cost	X	--Also looked at trainability, interoperability with MICV (now M2/3) and other systems. --Examined the possibility of an add-on missile. --This study reviewed the XM-1 requirements document in light of lessons learned from the 1973 Arab/Israeli War and the updated Soviet threat.
Armored Reconnaissance Scout Vehicle Study (ARSV)+	X		X		X			X	X	--Compaired capabilities and cost of the scout vehicle then under development with the capabilities and cost of a modified infantry combat vehicle, also under development. --Decision was to abandon the ARSV program and modify the infantry vehicle to accomplish both roles. --Result was development of the Bradley (M2/3) Vehicles.
High Mobility/ Agility(HIMAG) Chasis Research Test (Hit Avoidance Test)*	X		X		X					--Repeated portions HIMAGIIA over realistic terrain. --Faster targets are engaged less frequently. --Gunners tracking may be degraded by increasing mobility/ agility in conjunction with breaks in target intervisibility. --Gunners have difficulty reacquiring targets once they are lost from view.
S-Tank Agility/Survivability (STAGS) Test+	X		X		X					--Probability of a hit (P_h) decreases as mobility/agility levels of target vehicles increase. --The most effective maneuvers are those which do not result in a substantial speed reduction. --The more violent maneuvers result in speed loss and are less effective. --P_h tends to decrease as the HP/ton ratio of the target vehicle increases.

Anti-tank Missile Test (ATMT)+	X	X	X		X			--The best results were achieved by the vehicles which maintained the fastest speed between covered points. --The "dash" is the most effective maneuver for slow vehicles. --A variety of fast and slow vehicles were used as targets in this test. --Test conducted with cannon only--no missiles. --No significant difference among target evasive maneuvers in terms of gunner tracking error. --Against ATGM the payoff of hit avoidance maneuvers are negligible. --Test applies to missiles only--no cannon.
Development and Analysis of Tank Evasion Strategies in Missile Effectiveness Models			X					--Provided system for quantifying survivability tradeoffs, including tank threat warning systems, evasive maneuver computer systems, acceleration, deceleration, and turning performance.
Comparative Evaluation of Ride-Normal, Prone, Supine Seating in a Light Combat Vehicle*	X							--Evaluated ride comfort of three seating positions in terms of acceleration, absorbed power, and ride severity. --Seating positions ranked (in order) supine, normal (seated), and prone.
Special Study of High Mobility/ Agility (HIMAG) Chassis Test	X		X		X			--Roadwheel travel is the most significant mobility variable. --Center of gravity is not a significant influence. --Harness and shoulder belts improve driver safety. --Drivers are not inhibited by speed/mobility.
High Mobility/Agility (HIMAG) Phase IIA Survivabil-	X		X		X			--Test was conducted on flat terrain with no breaks in intervisibility. --Target was a specially equipped El Camino truck capable of 10 meters/sec acceleration. --Gunner performance with modern AT Gun systems and "Command

ity Test (El Camino)										to line of sight" missiles not significantly degraded by target maneuvers. --Automatic linear lead system signigicantly increases gunner performance. --Total gun pointing (TGP) error increases with range, but not affected by target velocity.
Armor/Anti-Armor Combat Survivability Model (MOBAG)	X		X		X					--Fast vehicle survivability is increased by employing maneuvers rather than straight line dashes. --Increased mobility reduces exposure times. --Most existing combat models require more realistic data in order to accurately portray the effects of mobility/agility.
Moving Target Simulation (MTS)*			X							--Confirmed results of HIMAG IIA (El Camino) Test. --Performed inside a building using a laser sopt projected on a screen to simulate target motion. --Gunners were able to track spot easier than a normal target.
Influence of Terrain Intervisibility on the Performance of Antitank Guided Missiles	X		X							--Used terrain characteristics of Fulda region, FRG. --Terrain intervisibility characteristics are highly sight dependent. --ATGM effectiveness against mobile targets, under realistic battlefield conditions, could be significantly affected by the gunner's ability to reacquire intermittently intervisible targets. --Field of view limitations have no significant effect on target engagement outcome.
Mobile Protected Gun (MPG) Study*	X	X	X	X	X	X	X	X	X	--Field 90mm MPG. --Don't use M551 as a substitute. --Technology won't allow 90mm MPG to be fielded before 1990. --Threat will change, therefore redefine in 1987. --Interim solution should be a 6x6 armored car with 25mm gun coupled with HMMWV with 6-inch TOW Missile.
Armored Combat Vehicle Technology (ACVT) Study	X	X	X	X	X	X		X	X	--Defined the design parameters for a lightweight, armored combat vehicle. --Initiated a number of new technologies that offer potential if further developed. --Demonstrated sophisticated new testing techniques. --Updated models.

ament Technology Study		X					X			--Looked at currently available gun and missile systems. --Examined emerging top and bottom attack capabilities. --Postulated on the potential for liquid propellant, railguns, electro-magnetic guns, traveling charge, and new fire control systems. --A comprehensive look at where we are. --Tried to justify development of a 135mm gun.
Advanced Anti-Armor Vehicle Evaluation (ARMVAL)	X	X	X		X					--Confirmed in a force-on-force test much of what earlier tests had concluded. --Minimum exposure time is better. --High mobility targets not only reduce P_h, but also the number of times fired upon. --Slalom is the best maneuver against a TOW type system if it does not increase exposure time by more than 12 percent; otherwise, go in a straight line dash.
Future Close Combat Vehicle System Study (FCCVS)	X	X	X	X	X	X	X	X	X	--A TACOM/TRADOC attempt to tap the best minds in industry to tell us what types of future systems we may require by 1995-2000. --Based on the Air-Land Battle Doctrine. --Three contractor teams participated. --CG, TRADOC said look was not far enough out in the future. Told them to look at 2020.
FCCVS II	X	X	X	X	X	X	X	X	X	--Each contractor identified several technologies as pacing items for future system development. --Vehicle and weapon system families and combinations of families were proposed to address the various battlefield missions.
Armor Force Needs and Initiatives	X	X	X				X			--An attempt to combine resources, organizations, money, technology, etc. so as to "leap ahead." --Close look at impact of training, Battlefield Management Systems (BMS), and sensors. --Proposed organizational solutions to CSS problems. --Recommended better testing of key technologies, organizational concepts, and better training.
Tank Armament Review Group (TARG)		X	X							--Also looked at fightability of systems, testing personnel, new technologies, and re-examined the 105mm VS 120mm VS 120mm upgrade program. --Concluded that several key technologies should be studied further and funded.

TARG Follow-on			X	X	X	X				--Picked up where TARG left off and searched for "Leap-Ahead" technologies. --Used much data from the FCCVS Studies.
Army Tank Program Analysis (ATPA)		(X)	(X)	X				(X)		--Looked closely at procurement practices, personnel, training, USAR/ARNG structure, distribution of resources and tried to identify options for trade-offs. --Identified "billpayers."
Future Armor Combat System (FACS)	X	X	X		X					--Concerned with technology assesment as a follow-on to TARG and TARG-FO. --Conducted concurrently with ATPA to include publication of a joint report. --Models not updated to include current ALB Doctrine. --Looked closely at Threat. --Recommend formation of a Special Study Group to develop the requirements documents.
Special Study Group, Armor (CROW TF)	X	X	X	X	X		X	X	X	--Saved as the second set of eyes to FACS. --Tasked to develop requirements documents. --Agreed with FACS that the requirement existed, but disagreed on the approach. --Additionally, looked closely at the command, control, communications, and intelligence (C^3I) requirements and reviewed threat.
TOTALS	19	13	23	7	17	5	6	7	7	

APPENDIX B

GLOSSARY

The following terms and accronyms are used in this paper and the matrix and Appendix A. The definitions offered here are offered to help the reader clarify terms with which he or she may not be familiar.

Agility - The ease with which a person, vehicle, or weapons system moves about the battlefield, especially the ability to abruptly change directions.

ARSV - Armored Reconnaissance Scout Vehicle. The developmental system that immediately preceded the cavalry version of the Bradley Fighting Vehicle, M3.

Bottom Attack - Another term for landmines.

Cost Effectiveness - Cost and Operational Effectiveness Analysis (COEA). The process of examining the cost of a system against its expected contribution to an organization's combat power. Usually, this technique is used when comparing alternative systems/solutions to determine which offers the greatest gain for the dollars expended.

Electromagnetic Guns - Experimental guns which use a sequenced flow of electromagnetic energy to pull a projectile down a gun tube rather than an explosive charge.

HMMWV - High Mobility Multi-purpose Wheeled Vehicle. A vehicle currently being fielded to replace the 1/4 ton truck (Jeep) and the high-mobility 1 1/4 ton truck (Gamma Goat) in combat units.

HP/ton - The rated horsepower of a system divided by the weight of the system in tons. Usually expressed as a ratio (i.e. 25:1).

Lethality - The potential ability of a weapons system to destroy or severly damage enemy combat systems. Usually measured by an estimated fifty per cent chance of penetrating a given thickness of rolled homogenious armor (RHA) at a certain range, assuming a hit. The accuracy of the system is also calculated in this estimate by determining the probability of achieving a hit (P_h) at a given range.

Life Cycle Cost - The cost of ownership of any item of equipment throughout its expected useful life. This normally includes fuel, lubricants, maintenance to include labor and parts, transportation to expected area of use, crew, ammunition and anything else the system may require for normal operation.

Liquid Propellant Gun - Guns that operate by use of a combustion chamber into which is injected one or more liquids which are then ignited to propel the projectile down the tube.

MICV - Mechanized Infantry Combat Vehicle. The developmental system that immediately preceded the infantry version of the Bradley Fighting Vehicle System M2.

Mobility - The ability of a person or weapons system to move from one point to another as measured by time.

Railgun - An experimental system which uses a controlled explosive charge progressing down a rail to propel a projectile.

Roadwheel Travel - The distance the roadwheel (i.e. the wheel of a track laying vehicle which rolls upon the roadway formed by the track) will travel before it hits the bumpstop. Normally, the greater the travel, the better the ride.

6X6 - A vehicle that has a total of six wheels on the ground and all six are powered (i.e. the family car has four wheels but only two are powered, hence it is a 4X2).

S-Tank - The Swedish main battle tank. Its unique design incorporates a fixed gun in the hull requiring movement of the entire vehicle for aiming, an extremely low profile and a compound (two engine)power system of a main diesel engine with a turbine booster. It was also designed for extremely high survivability.

Strategic Mobility - The ability of a weapons system or unit to be transported long distances within a given time in a ready-to-fight, or near ready-to-fight condition.

Survivability - The probability that a system will survive if hit by an enemy weapon and still be able to function.
- Sometimes used to describe the ability of a system to avoid being hit by hostile fire.

Tactical Mobility - The ability of a system or unit to move about the battlefield, usually within a single theater of operations.

Top Attack - A weapons system or munition which attacks a vehicle from its top; usually by being fired over the vehicle and exploding, forming an armor penetrating submunition designed to penetrate the top of a vehicle where there is normally less armor protection.

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